

ADAPTIVE VOICE RECOGNITION MENU METHOD AND SYSTEM

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of U.S. Patent  
Application Serial No. 10/135,143 entitled "Adaptive  
Voice Recognition Menu Method and System" filed on April  
5 30, 2002 by Benjamin A. Knott et al., now U.S. Patent No.  
\_\_\_\_\_.

TECHNICAL FIELD OF THE INVENTION

The present invention relates in general to the  
field of menus and content for automated responses to  
10 callers, and more particularly relates to a method and  
system for adapting voice recognition and touch-tone  
menus based on the frequency of caller requests for  
information and for adapting a voice recognition and  
touch-tone content for information retrieval systems.

BACKGROUND OF THE INVENTION

Telephone call centers handle millions of calls from consumers each year. One significant expense for call centers is the expense of training and maintaining  
5 operators to answer inbound calls and interact with callers to help callers complete their objectives. To manage and reduce costs, call centers typically rely on automated responses to caller inquiries so that fewer operators are needed for a given volume of inbound calls.  
10 For instance, inbound calls to a call center are answered by interactive voice response units that provide information to callers without operator intervention by interacting with callers through a DTMF tone-based menu. If callers are able to complete their objectives by  
15 interacting with automated systems, calling centers typically enjoy substantial cost savings.

One difficulty with the use of automated responses to caller inquiries is that the nature of caller inquiries to a calling center may vary substantially.  
20 Thus, automated menus tend to present a broad range of options for callers to select from. However, the greater the variety of possible caller objectives, the more complex the automated menu tends to grow. Complex menu options tend to discourage callers from pursuing their  
25 initial objectives due to the length of time typically needed to navigate through the menus. Often, callers end up with their objective unmet, giving up on the automated system in favor of waiting for an operator. Thus, complex navigation menus may fail in reducing operator  
30 workload while producing dissatisfied customers.

One solution that simplifies caller interaction with automated interactive voice response units is the ability

to apply voice recognition for determining caller inputs. Voice recognition allows callers to state a query which is analyzed to determine the desired information. Voice recognition enabled interactive response units are  
5 typically simpler to use than DTMF tone based systems since a caller is able to simply state a request without having to select from a defined list of menu items. However, voice recognition accuracy suffers when the glossary of terms to be recognized becomes large or when  
10 communication of voice utterances is unclear, such as with a bad telephone connection or an unclear speaker. Failure of voice recognition often leads to frustrated callers who are unable to obtain desired objectives or to even navigate through menus that require voice  
15 recognition.

Another difficulty with the use of automated responses to caller inquiries is that the content of the information provided to the caller is rarely updated and tailored to the callers needs over time. The content of  
20 the information provided has a high degree of validity and applicability on the day of implementation. However, over time, the callers needs, the technology, and other related systems change, thus establishing the requirement to update this content. Out-of-date content will  
25 discourage callers from using the automated systems. Thus, the automated systems will fail to reduce operator workload while producing dissatisfied customers.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention may be better understood, and its numerous objects, features and advantages made apparent to those skilled in the art by referencing the accompanying drawings. The use of the same reference  
5 number throughout the several figures designates a like or similar element.

Figure 1 depicts a block diagram of a system for presenting voice prompt menu options based on the  
10 frequency of caller requests for information;

Figure 2 depicts a flow diagram of an opening menu for providing frequently requested information on telephone services;

Figure 3 depicts a flow diagram of a subsequent menu  
15 for providing frequently requested information on how to use telephone services;

Figure 4 depicts a flow diagram of a subsequent menu for providing frequently requested information on the cost of telephone services;

20 Figure 5 depicts a flow diagram of a subsequent menu for providing frequently requested information on services subscribed by a caller;

Figure 6 depicts a flow diagram of a subsequent menu for providing frequently requested information on a  
25 caller's long distance carrier; and

Figure 7 depicts a flow diagram for updating menu content with caller feedback.

DETAILED DESCRIPTION OF THE INVENTION

A speech-recognition enabled, interactive voice response system presents an adaptable menu to callers to obtain information over a telephone with speech or touch-  
5 tone DTMF inputs. The customer-centric menu arranges nodes based on call frequency for classifications of information. The frequency of requests for information based on the classification of the information adapts menu options to be presented in an order that relates to  
10 the likelihood of a request for information by a caller, thus providing a more rapid location of desired information. Analysis of opening statements made by callers identifies tasks of callers upon initial contact and relates the tasks to information classifications.  
15 The adaptable menu nodes allow callers to navigate quickly to desired information by applying voice recognition to caller inputs responsive to an initial prompt for the caller's task. Menu nodes list menu options based on the frequency of requests for  
20 classifications of information and include DTMF touch-tone input options for each information classification. In one embodiment, a menu adapted to provide frequently requested information on telephone services provides a reduction in the navigation time of callers and a  
25 reduction in caller reliance on operators.

An automated system presents adaptable content to callers to obtain current and appropriate information. Customer-centric content is updated based on frequency of customer feedback. The frequency of customer feedback  
30 provides a basis for updating the content, thus providing more current and usable information. The adaptable content allows callers to retrieve current and usable

information by automatically updating the content based on customer feedback. This updated content is the sequence of information and the content itself.

Referring to Figure 1, a block diagram depicts a system for analyzing call request topics and setting a call menu for improved automated response in accomplishing caller tasks. An interactive voice response unit (IVR) 10 provides speech and touch-tone enabled interactive voice responses that allow callers interfaced through a communication network 12 and telephones 14 to obtain information. The embodiment depicted by Figure 1 uses telephone communication through the Public Switched Telephone Network (PSTN), although alternative embodiments include mobile or computer telephony devices communicated through the Internet or other suitable networks. If a caller is unable to receive information from the automated responses of IVR 10, then the caller is forwarded to an operator 16 interfaced with IVR 10 for individual handling.

Callers establish communication with IVR 10 by, for instance, placing a telephone call with telephones 14 through PSTN 12 to a predetermined telephone number associated with IVR 10. As one example, callers request information about their telephone service by dialing a number provided on their bill or advertised on their telephone book. IVR 10 provides a voice menu that directs callers to input information requests through either a voice response or a touch-tone response. A menu 18 interfaces with IVR 10 to provide callers with menu nodes that guide callers to accomplish specific desired tasks. Menu 18 has a data-driven design with dual speech and touch-tone input options. Menu options are presented

to aid callers in completing specific tasks with the order and selection of menu option presentation based on an analysis of the frequency of caller requests for specific tasks. A task analyzer 20 interfaces with IVR  
5 10 to analyze the frequency of requested caller tasks from caller requests to IVR 10. A menu graphical user interface (GUI) 22 provides access to the task analysis and interfaces with menu 18 to arrange menu nodes according to the analysis of the frequency of task  
10 requests, thus allowing users to more efficiently accomplish desired tasks.

In one embodiment, menu 18 provides an automated service that provides callers with information about current telephone services, product or service  
15 availability and pricing, and operating instructions for how to use services. Menu 18 presents voice responses to callers to request input of and to address the specific caller task, such as the specific service and associated information requested by the caller, based upon the  
20 analysis of the frequency of requests for the specific task. By ordering menu options to address tasks by their requested frequency, menu 18 expedites the identification of caller tasks and helps ensure accurate and timely transfer of requested information, thus reducing the  
25 likelihood that a caller will request or need operator intervention. Task analyzer 20 identifies requested information by frequency and provides the task frequency to menu GUI 22 for organizing menu 18. In one alternative embodiment, task analyzer 20 automatically  
30 updates menu content and order based on frequency analysis, either on a periodic basis or when significant frequency changes are noted. Task analyzer 20

automatically implements menu updates and identifies the updates to system administration through menu GUI 22.

In one specific example, task analyzer 20 analyzed the "opening statements" of callers to determine the caller's intention, *i.e.*, the task that the caller sought to complete in the call, and arranged menu 18 to respond to caller requests according to task frequency. Analysis of 3000 opening statements identified 15.6% of calls as requests for information about telephone products and services that are efficiently handled by automated responses. For instance, the opening statement may be a caller utterance to an operator or a speech-enabled IVR main menu request in which the user states the purpose of the call. These requests for information are classified into six high-level user task categories:

1	"What is" or "How to use" a feature or	33%
2	Pre-purchase information.	18%
3	"What service do I have?" or "Do I have a service?"	14%
4	"How much does a service cost?"	13%
5	Post-purchase information.	10%
6	"Who is my Long Distance provider?"	6%
7	Other	6%

The most frequent request for information is for instructions describing how to use a telephone service, such as Caller ID, call blocking or call forwarding. Next in frequency are requests for information about services available for purchase, such as Internet DSL service, new phone service or wireless phone service. Third in frequency are requests for information about the



services that the caller already has. Fourth in frequency are requests for the cost of services, such as adding a second telephone line or Caller ID. Fifth in frequency are requests for post-purchase information, such as changing or updating a service. Sixth in frequency are requests for identification of the caller's long distance carrier.

Based upon this frequency analysis, menu 18 provides six primary functions associated with the identified caller tasks so that caller requests for information are more rapidly identified and addressed. Referring now to Figure 2, a flow diagram depicts the initial menu node presented to a caller to provide information for the six frequent tasks identified by the task analyzer. The process begins at step 24, for instance, with the calling of a predetermined phone number by a customer to establish communication with IVR 10, and proceeds to a general greeting at step 26. The general greeting identifies the purpose of the automated voice and touch-tone service as providing information in response to caller requests and instructs the caller how to make an opening statement regarding the purpose of the call or to wait for a list of menu items. For instance, the general greeting explains that the caller has the option of relying on voice recognition or touch-tone inputs to navigate the menu by stating an utterance or inputting a DTMF tone at any time.

After the greeting, the process proceeds to step 28 where the caller is instructed to "Please identify your task," followed by a pause to allow an opening statement utterance. IVR 10 then lists the menu options and an associated DTMF tone in a predetermined order, such as in

10

the order of frequency of the requests by callers. For instance, an example script read by IVR 10 at step 28 is:

"Please identify your task."

"One. How to use a service."

5 "Two. Sales information about a service."

"Three. What services do I currently have."

"Four. How much does a service cost."

"Five. Get information about one of my services."

"Six. Who is my long distance carrier."

10 The order for the list of menu options corresponds to the frequency with which requests for each type of information are made as determined by task analyzer 20. The caller may select a type of information by an appropriate utterance or by inputting a DTMF tone.

15 At step 30, IVR 10 accepts the caller input, determines the menu node selected by the caller input and advances the input to task analyzer 20 for classification of the task requested by the caller. Analysis of user tasks is thus updated to maintain a current list of  
20 frequently requested tasks. For instance, automated analysis may be performed to determine caller tasks and associated utterances or, alternatively, opening statements may be recorded for later play back and analysis. Frequent analysis allows prompt and efficient  
25 updates to menu 18 to improve response times and flows for caller requests for information by allowing adjustments to menu 18 in a timely manner. For instance, if a network problem arises which causes a surge in caller requests for post-purchase information, such as a  
30 surge in requests for Internet service status when the network has difficulty, task analyzer 20 provides notification through menu GUI 22 so that menu 18 is updated to an order corresponding with the increased frequency of requests for post-purchase information.

Thus, callers are presented with the option to request post-purchase information more quickly, reducing the time needed by callers to accomplish a task. This reduces caller frustration for the most frequent call information  
5 classifications and also reduces the resource demands on the call center equipment, such as voice recognition and text to speech processors, thereby reducing the overall cost of the application.

IVR 10 determines the category of the task  
10 associated with the caller's request for information and forwards the caller to a menu node associated with the task. For instance, at step 34 the caller is advanced to a menu node for information on how to use a service with either an appropriate utterance or the selection of DTMF  
15 tone 1. Examples of utterances that result in advancing to a menu node on how to use a service are: "How do I set up a service?" "How do I use a service?" and "How does a service work?" Some examples of services include call blocking, Caller ID, message center, call forwarding  
20 and long distance. The likelihood of accurate recognition of utterances by IVR 10 is improved by narrowing the glossary of recognized terms while including a variety of terms that may be associated with a user request for information. Thus, for instance,  
25 examples of other types of utterances that result in advancing to the "how to use" menu node associated with step 34 include: "Can I?" "What ways can I?" "Why can't I" and "Why has?" In one embodiment, task analyzer 20 tracks terms uttered by callers to associate terms with  
30 task categories, resulting in more accurate application of voice recognition to determine tasks.

From step 30, IVR 10 advances callers to menu nodes associated with tasks based on either the DTMF tone or utterance input of the user. For instance, at step 36, a caller is advanced to a pre-purchase menu node upon  
5 selection of DTMF tone 2 or recognition of an utterance associated with a request for pre-purchase information, such as: "I want a service." "Is a service available?" "Can I get a new service?" "Can you send?" "I did not get information." and "What does a service cover?" At  
10 step 38, a caller is advanced to a current services menu node upon selection of DTMF tone 3 or recognition of an utterance associated with a request for information about the caller's current services, such as: "Do I have a service?" or "What services do I have?" At step 40, a  
15 caller is advanced to a cost menu node upon selection of DTMF tone 4 or recognition of an utterance associated with a request for information about service costs, such as: "How much does it cost to add a service?" "How much is a service?" and "How much does it cost to get a new  
20 service?" At step 42, a caller is advanced to a post-purchase menu node upon selection of a DTMF tone of 5 or recognition of an utterance associated with a request for post-purchase information, such as: "I want to change a service." "Who is my service provider?" "Is my service  
25 still the same?" "My service connection is bad." and "Can I password protect my service?" At step 44, a caller is advanced to a long distance menu node upon selection of a DTMF tone of 6 or recognition of an utterance associated with a request for information about  
30 a caller's long distance provider, such as: "What long distance company do I have?" or "Why do I have this company as my long distance provider?" If a caller fails

to select a recognized DTMF tone or utterance, the process proceeds to step 46 to allow the caller to select interaction with an operator.

Referring now to Figure 3, a flow diagram depicts the process for presenting "how to use" information. A caller request for "how to use" information at step 34 of Figure 2 initiates the process at step 48 of Figure 3. At step 50, the caller is provided with a greeting that explains the purpose of the menu node, the services for which information is available, and the availability of either voice recognition or touch-tone inputs for the caller to request information. At step 52, the caller is requested to input the service of interest and the caller's area code or state. For instance, a script instructs the caller to state a service for which information is available, such as call blocking, caller ID, message center and call forwarding, or to input a DTMF tone of 1 through 4 with each tone associated with a service. The caller is also instructed to input an area code or state since service offerings may vary by calling area. The area code and state information may be input by a caller utterance or by using the phone keypad.

At step 54, IVR 10 determines the service and service area input by the caller and, at step 56, forwards the input to task analyzer 20. Analysis of caller inputs is useful in several ways. For instance, relating caller inputs at step 54 with opening statements at 30 allows more specific identification of a caller's initial task and the adapting of voice recognition nodes and glossaries so that opening statements have an increased likelihood of resulting in advancement to an appropriate menu node. Analysis of caller inputs at step

56 also aids in tailoring the "how to use" menu node so that callers are advanced to desired information in a rapid and accurate manner. For instance, the glossary for the menu node is adapted to recognize expected terms, thus improving recognition speed and accuracy. In addition, the menu items are arranged in terms of the frequency in which they are chosen, such that the more frequently selected menu items are listed higher on the menu.

10       At step 58, IVR 10 retrieves the service information available for the area input by the caller. For instance, service offerings and functionality may vary based on service areas. At step 60, a script presents the caller with the types of information available for  
15       the selected service and instructs the caller to select desired information by either a voice utterance or DTMF selection. For instance, the caller is presented with four types of information for the identified service. One type of information is a description of service  
20       functionality such as the definition of the service and its objectives. Another type of information is set up information, such as instructions for turning the service on and off. Another type of information is usage information, such as instructions on how to use the  
25       service. Another type of information is how to change service functions. The script for each service varies dependent upon the type of information available for the service, and includes DTMF inputs as well as voice recognition inputs for the caller to select desired  
30       information.

      At step 62, the caller inputs a DTMF tone or speech utterance to navigate for the four types of identified

information and the caller's input is forwarded to task analyzer 20. For instance, if the caller inputs a DTMF tone of 1 or requests a definition for a service, the process proceeds to step 64 to provide explanations of definitions and functions for the identified service. If a caller selects a DTMF tone of 2 or requests instructions for set up of a service, the process proceeds to step 66 for instructions on the set up of the identified service. If a caller selects a DTMF tone of 3 or requests instructions for how to use the identified service, the process proceeds to step 68 for an explanation of how to use the service. If a caller selects a DTMF tone of 4 or requests changes to the settings of an identified service, the process proceeds to step 70 for instructions to perform the requested change.

Referring now to Figure 4, a flow diagram depicts the process for providing cost information for identified services. The process begins at step 72 with the identification of a request for cost information at step 40 of Figure 2. The process proceeds through a greeting at step 74 with an explanation of the information available at the node through the selection of either a DTMF tone or voice utterance. At step 76, the caller is requested to input the service for which cost information is sought and the area code or state of the caller. For instance, frequent requests for cost information include requests for information on the cost of a second telephone line, caller ID, or other new services that are listed along with DTMF tone selection options.

At step 78, the caller identifies the service of interest with a DTMF tone or utterance to IVR 10, which

forwards the selection to task analyzer 20 at step 80 as previously described. At step 82, the cost information for the identified service or package of services is retrieved for the identified state or area code and, at  
5 step 84 presented to the caller. Although the initial task of the caller was to obtain cost information, such requests for cost information are often followed by requests to learn more about or purchase identified services. At step 86, the caller is presented with  
10 options to find the cost of another service, purchase the identified service or terminate the call. At step 88, the caller inputs a DTMF tone or utterance, which is forward to task analyzer 20. If the caller selects a DTMF tone of 1 or states a request for cost information  
15 of another service, the process proceeds to step 90 and returns to step 82 to allow the user to select another service. If the caller selects a DTMF tone of 2 or states a request for purchase information, the process proceeds to step 92 to advance the caller to a menu node  
20 of service purchase. If the caller selects a DTMF tone of 3 or requests termination of the call, the process proceeds to step 94 at which the call is terminated.

Referring now to Figure 5, a flow diagram depicts the process for providing "what service do I have"  
25 information for a caller. The process begins at step 96, such as from a request for such information at step 38 of Figure 2. At step 98, the caller is provided a greeting that explains the purpose of the menu node and the availability of DTMF or voice utterance selection. At  
30 step 100, the caller is requested to provide the area code and telephone number to identify the services. At step 102, the caller inputs the area code and telephone



number, either with an utterance or DTMF tones, and the input is provided to task analyzer 20 at step 104. At step 106, the requested information is retrieved and, at step 108, the caller is presented with a list of service  
5 names that are provided to the identified phone number.

When a caller requests information regarding existing services, requests related to the existing services frequently follow. At step 110, the caller is presented with menu options that address information  
10 requests or tasks that frequently follow requests for information on existing services. For instance, the caller is presented with options to select DTMF tones or state utterances to obtain instructions for use of services, billing costs or questions, handling moves by  
15 the caller, purchase of other services or terminating the call. At step 112, the caller inputs a DTMF tone or statement to accomplish a desired task, and the caller's input is forwarded to task analyzer 20. If the caller requests information on how to use a service, at step 114  
20 the caller is advanced to a "how to use" menu node, such as at steps 48 or 68 of Figure 3. If the caller requests information on billing or costs, at step 116, the caller is advanced to a menu node that provides billing or cost information. If the caller requests information on  
25 handling a move, then at step 118 the caller is advanced to a menu node that provides information on moving telephone service and change of address. If the caller requests information on purchasing additional services, then at step 120 the caller is advanced to a menu node to  
30 allow service purchase. If the caller requests termination of the call, then at step 122, the caller is advanced to a menu node for call termination.

Referring now to Figure 6, a flow diagram depicts the process for providing identification of long distance provider information. The process begins at step 124, such as from a caller request for long distance provider information at step 44 of Figure 2, and proceeds to step 126 at which the caller is greeted with an explanation of the menu node. At step 128, the caller is requested to provide the area code and telephone number either with DTMF tones or voice utterances and, at step 132 the caller input is provided to task analyzer 20. At step 134, the long distance carrier information for the input area code and telephone number are retrieved and, at step 136, the long distance carrier information is provided to the caller.

Requests by callers for long distance carrier information frequently result in additional requests for related information, such as reporting of "slam" changes, billing inquiries, and requests to change the long distance carrier. At step 138, the caller is presented with menu options for requests related to long distance carrier information, including DTMF tone or voice utterance input options. At step 140, the caller inputs a selection which is forwarded to task analyzer 20. If the caller requests to report a slamming event, then at step 142 the caller is advanced to a menu node for reporting slamming complaints. If the caller requests billing or cost information, then at step 144 the caller is advanced to a menu node for providing cost or billing information. If the caller requests a change to the long distance provider, then at step 146 the caller is advanced to a menu node for changing the long distance provider. If the caller requests to terminate the call,

then at step 148 the caller is advanced to a menu node for terminating the call.

Referring now to Figure 7, a flow diagram depicts one embodiment for updating menu content with caller  
5 feedback. The process begins at step 750, such as upon the completion by a caller of retrieval of How To Use at step 68 of Figure 3. At step 752, the caller is asked to provide feedback, such as comments about the quality, validity and usefulness of the information provided. A  
10 content analyzer 754 receives, records and analyzes the feedback. For instance, content analyzer 754 may record caller comments for playback by system administrators, or may evaluate comments based on speech recognition, resulting in updates to the content of the associated  
15 menu node.

Although the present invention has been described in detail, it should be understood that various changes, substitutions and alterations can be made hereto without departing from the spirit and scope of the invention as  
20 defined by the appended claims.